Editorial

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The research into neural information processing aims to develop computational tools for understanding how the human brain works as well as how to apply this knowledge to build artificial intelligence systems. It is a multidisciplinary research area, attracting researchers from both biological learning systems and artificial learning systems. Nowadays, the focus in that area covers a wide spectrum in relation with machine learning, artificial intelligence, cognitive science, as well as computational neuroscience. This would lead to creation of more powerful brain-inspired machine learning models based on better understanding of human brains.

On the other hand, phenomena and principles found from nature offer a valuable insight and perspective of how effective learning can be conducted in both biological and artificial systems. Many intelligent methods based on natural principles have been developed to facilitate new models of learning across different domains. Nature inspired learning is now an active research field, where a variety of theories and approaches originating from the natural world, particularly from biological and physical systems, are being exploited to address complex learning tasks that are hard to handle with conventional learning techniques.

The special issue aims to explore the relationship between Nature-Inspired Learning and Neural Information Processing and to find new ways to bridge these two exciting research areas for building hybrid systems with stronger learning capability. The 14 high quality papers in this issue are selected from a total of 87 submissions, some of which were extended versions of papers in the 2014 10th International Conference on Natural Computation (ICNC 2014) and the 2014 11th International Conference on Fuzzy Systems and Knowledge Discovery (FSKD 2014), after three rounds of review. In the following we provide a brief introduction to each accepted paper.

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The paper “Training neural networks with Krill Herd Algorithm” by Kowalski and Lukasik studies the usage of the Krill Herd Algorithm (KHA), inspired from biological swarming behavior of krill herd found in ocean, for optimizing parameters within Artificial Neural Networks (ANNs). The tests on several benchmark datasets have indicated that KHA can offer promising performance in both classification accuracy and the time needed for ANN training, compared with other heuristic methods and a gradient algorithm.

In the paper “An evolutionary radial basis function neural network with robust genetic-based immunecomputing for online tracking control of autonomous robots”, Huang and Chiang proposes a hybrid paradigm of genetic algorithm and artificial immune system (GAAIS), which is used to determine the optimal structure of the radial basis function neural network (RBFNN) for tracking control of autonomous robots. The GAAIS-RBFNN based scheme has been implemented in field-programmable gate array (FPGA) for real-time control, showing its stronger capability in trajectory tracking than RBFNN controllers using GA or AIS alone.

The paper “An improved neural network with random weights using backtracking search algorithm” by Wang et al. focuses on neural networks with random weights (NNRWs) for fast learning speed. The authors suggest the employment of the backtracking search algorithm (BSA), as a new evolutionary algorithm, to optimize the hidden layer parameters of a single layer feed-forward network. Experiments on classification and regression problems show the promising performance of applying BSA for parameter learning within NNSWs.

The paper “Adaptive network-based fuzzy inference systems coupled with genetic algorithms for predicting soil permeability coefficient” by Ganjidoost, Mousavi and Soroush deals with an adaptive network-based fuzzy inference system (ANFIS) coupled with genetic algorithm (GA) for predicting soil permeability coefficient. The fuzzy rule base structure of ANFIS is determined via application of GA in a subtractive clustering procedure, while the parameters of the fuzzy inference system are adjusted by a hybrid learning algorithm that is used to train the network.

In the paper “Inverse back analysis based on evolutionary neural networks for underground engineering”, Gao develops a new evolutionary neural network based on immunized evolutionary programming, in which the network structure and connection weights evolve simultaneously. This neural network with incorporation of evolutionary computing has shown to be effective for inverse back analysis in system identification for underground engineering.

The paper “Computation by time” by Walter, Röhrbein and Knoll investigates the time issue in spiking neural networks in order to identify new ways of biologically inspired neural information processing. It was illustrated how exact modelling of time (in spiking networks) could offer basis of powerful neurobiological systems. The authors also proved the plausible applicability of spiking neural networks to real-world problems such as pattern recognition and path planning.

The paper “A cognitive architecture based on a learning classifier system with spiking classifiers” by Howard, Bull, and Lanzi aims to build learning classifier system (LCS) as a cognitive architecture. It comprises a population of spiking neural networks as classifiers whose structures are automatically evolved by GA. Further, the spiking classifiers are coupled with a temporal reinforcement learning algorithm giving rise to stronger problem solving performance than those of other neural classifier systems.

The paper “A network of neural oscillators for fractal pattern recognition” by Oliveira and Zhao explores a ring of neural oscillators for pattern recognition. Particularly, attention has been made to the chaotic dynamics of the closed loops of Stuart-Landau Oscillators as artificial neurons. Manipulation of the number of such neurons as well as the initial conditions of the oscillators enables the network to encode different fractal patterns.

The paper “A resource aware MapReduce based parallel SVM for large scale image classifications” by Guo et al. presents a resource aware MapReduce based parallel support vector machine algorithm (RASMO) for large scale image classification. Therein a GA based scheme is developed to balance the loads among a cluster of computers to optimize the overall performance. The evaluation results show the merit of RASMO in significant reduction of the training time while maintaining high accuracy of classification.

In the paper “Motor imagery electroencephalograph classification based on optimized support vector machine by magnetic bacteria optimization algorithm”, Mo and Zhao propose the application of the magnetic bacteria optimization algorithm (MBOA) for parameter setting in support vector machine (SVM). The optimized SVM has been tested in motor imagery electroencephalograph classification problems, and the results show that it outperforms some other biologically inspired algorithms in this context.

The paper “Hybrid harmony search combined with stochastic local search for feature selection” by Nekkaa and Boughaci proposes a hybrid search method: HAS-SLS, which combines harmony search algorithm and stochastic local search to identify the most relevant features for data classification with SVM. Moreover, a novel probabilistic strategy is employed in HAS-SLS to select solutions to undergo local refinement for reaching a good trade-off between exploration and exploitation in the search process.

In the paper “Unsupervised clustering based an adaptive particle swarm optimization algorithm”, Ali put forwards a new variant of the particle swarm optimization (PSO) algorithm tailored to clustering analysis. The new algorithm is characterized by the representation of each particle with two dimensions corresponding to the number of clusters and centroids of clusters respectively. A new position updating rule is also proposed in accordance with the objective of the clustering task.

The paper “An SNN-based semantic role labeling model with its network parameters optimized using an improved PSO algorithm” by Huang, Chen, and Shi presents an improved PSO algorithm based on log-linear model to promote effective usage of different knowledge sources. The new PSO algorithm is further employed for optimization of parameters of a synergetic neural network that deals with semantic role labeling in natural language processing with high performance.

The paper “Memcomputing implementation of ant colony optimization” by Pershin and Ventra discusses the similarity and difference between memcomputing and ant colony optimization (ASO). It is pointed out that, by using appropriate memristive elements, there is almost one-to-one correspondence between memcomputing and ACO approaches. A major advantage of memristive network is that it can find the solution in one deterministic step, while ACO requires stochastic multiple steps to reach the same solution.

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